

REMARKS

This is in response to the Office Action that was mailed on April 28, 2003. Claim 11 is amended based upon disclosure in line 5 on page 25. See also claim 17. Claim 22 is amended based on claim 17 and page 6, lines 4-14.

New claim 24 is added, based on page 1, line 5. New claim 25 is added, based on page 22, line 22 through page 23, line 8. No new matter has been introduced. Claims 1-13, 15-18, 20, and 22-25 are in the case.

Objection was raised to claim 12. The objection has been overcome by the amendment of claim 11.

Claims 1-13, 15-18, 20, 22, and 23 were rejected under the second paragraph of 35 U.S.C. §112. It is respectfully submitted that the claims in their present form satisfy the requirements of the statute.

The Examiner objected to the use of the terminology "cellulose acetate compound" and implied that Applicants should instead refer to "cellulose acetate derivatives". In an interview on January 18, 2002, Examiner Everett White and Gary Geist had indicated that claims containing the terminology "cellulose triacetate compound" satisfied the requirements of the first and second paragraphs of 35 U.S.C. §112. As the Examiner will recall, the term "compound" was inserted to address the concern expressed in a previous Office action about whether the carboxyl groups are covalently bonded to the cellulose acetate, and secondly, to differentiate the compound claims from composition claims 11, 12, and 18. Nevertheless, in the spirit of advancing the prosecution of this application – if the terminology "cellulose triacetate derivative" is clearly distinguished from the Sullivan reference by the phrase

“with a reactant consisting essentially of acetic anhydride” – Applicants are willing to employ the terminology “cellulose triacetate derivative” should the Examiner now believe that such is necessary to properly define the invention.

The Examiner indicated that claim 22 set forth process steps that were not recited in claim 17. Claim 22 has been amended to obviate this ground of rejection.

THE INVENTION

Cellulose acetate derivatives are useful for the production of films and fibers. When used as a substrate for photosensitive materials, as a liquid crystal protective film, or as a color film, cellulose triacetate film is required to have satisfactory optical characteristics, including high transparency, a low yellowness index, low haze characteristics, and low birefringence. Specification, page 1, lines 4-23.

Cellulose acetate films are generally produced by the acetylation of pulp, casting a solution (dope) containing the resulting cellulose acetate derivative and a solvent onto a support, and releasing the resulting film from the support. The use of a linter pulp generally makes this process too costly. Supplies of high purity softwood pulp are not consistently available. Low purity softwood pulp produces cellulose acetate that is insufficiently transparent. Hardwood pulp generally provides cast film with unsatisfactory release properties. Also, cellulose acetate obtained from low purity pulp has decreased spinnability. Specification, page 1, line 24 – page 2, line 16.

In one embodiment, the present invention is based upon the discovery that the form of the carboxyl group binding to the cellulose acetate has a remarkable effect on the releasability and transparency of a cellulose acetate

film and on the spinnability of a cellulose acetate dope. In another embodiment, the present invention is based upon the discovery that the alkali or alkaline earth metal content in the cellulose acetate has a remarkable effect on the releasability and transparency of a cellulose acetate film and on the spinnability of a cellulose acetate dope. Specification, page 3, lines 8-15.

In a first aspect, the present invention provides a cellulose triacetate derivative obtained by the reaction of a cellulose with acetic anhydride in the presence of a sulfuric acid catalyst, wherein (i) the cellulose triacetate derivative has carboxyl groups and at least part of the carboxyl groups are free carboxyl groups. In this aspect, preferably at least about 30 mole-% of the total carboxyl groups bound to the cellulose triacetate are free carboxyl groups. Specification, page 13, lines 17-27.

In a second aspect, the present invention provides a cellulose triacetate derivative obtained by the reaction of a cellulose with acetic anhydride in the presence of a sulfuric acid catalyst, wherein (ii) the cellulose triacetate derivative contains an acid having an acid dissociation exponent pKa of 1.93 to 4.50 in water, or an alkali or alkaline earth metal salt of that acid, to generate free carboxyl groups. See Claim 1. The total content of the acid and metal salt is set at a level that does not interfere with releasability, transparency, or spinnability. See the specification, page 17, line 22 – page 18, line 3.

In a third aspect, the present invention provides a cellulose triacetate derivative obtained by the reaction of a cellulose with acetic anhydride in the presence of a sulfuric acid catalyst, wherein (iii) the cellulose triacetate derivative contains an alkali or alkaline earth metal and the total content of the metal in 1 gram of the cellulose triacetate derivative is 5.5×10^{-6} equivalent or less in terms of ion equivalent, to generate free carboxyl groups. Claim 1. The

minimum level of the metal is set at a level that does not interfere with heat resistance of the cellulose acetate. Specification, page 19, lines 2-23.

In summary, then, a crucial feature of the present invention resides in the fact that a carboxyl group derived from cellulose as a raw material is retained in the form of a free carboxyl group, for example by using or adding an acid having a pKa of 1.93-4.50, that is, an acid which is stronger than acetic acid.

Claims 1-10, 13, 15, and 16 are drawn to the novel cellulose triacetate compounds (or derivatives) of this invention, as such. Claims 11, 12, 18, and 23-25 are drawn to compositions of matter (slurries, dopes, films) that include those novel cellulose triacetate compounds. Claims 17 and 22 are drawn to methods of making those novel cellulose triacetate compounds. Claim 20 is drawn to a method of using the novel composition of claim 18 (which novel composition incorporates the novel compounds).

THE PRIOR ART

Claims 1-10, 13, 15, and 16 were rejected under 35 U.S.C. §102(b) as being anticipated by GB 1,102,976 (Finlayson). Claims 1-13, 15, and 16 were rejected under 35 U.S.C. §103(a) as being unpatentable over Finlayson. Claims 1 and 4-10 were rejected under 35 U.S.C. §102(b) as being anticipated by US 4,426,481 (Sullivan). Claims 1 and 4-10 were rejected under 35 U.S.C. §102(b) as being anticipated by US 3,816,150 (Ishii). Claims 17 and 22 were rejected under 35 U.S.C. §103(a) as being unpatentable over Ishii in view of US 2,582,049 (Malm). Claims 18, 20, and 23 were rejected under 35 U.S.C. §102(b) as being anticipated by US 5,152,974 (Takeda).

The cited references

Finlayson discloses the production of cellulose triacetate "by the reaction ... between cellulose, in the form of pulp or linters, and an acetylating medium consisting of a mixture of acetic anhydride with a small proportion of a catalyst such as sulphuric acid ... and with other liquids ... which may be solvents for cellulose triacetate ... such as acetic acid or methylene chloride. Page 1, left column, lines 9-20. Finlayson mentions "the mixture from the slurry pump". Page 2, left column, lines 19-42.

Sullivan discloses a polymeric product, prepared by polymerization in an alkaline environment, adapted to utilization among other things as a diffusion control layer in diffusion transfer film units or as an interlayer or overcoat in photosensitive elements. Sullivan indicates that US Patent No. 3,362,819 discloses an image-receiving element comprising a support layer, made up of, in sequence, *a polymeric acid layer*, an inert timing or spacer layer, and an image-receiving layer. Column 4, lines 59-66. Sullivan further teaches that the acid polymer layer effects a reduction in the pH of the image layer, from a pH of about 12-14 to a pH at least as low as 11. Column 5, lines 41-44. Moreover, in order to prevent premature pH reduction during transfer processing, as evidenced for instance by an undesired reduction in positive image density, the acid groups are disclosed to be so distributed in the acid polymer layer that the rate of their availability to the alkali is controllable. Column 5, lines 53-58. Also, the polymeric acid may be made of a free carboxyl group-containing ***dibasic acid half-ester derivative of cellulose***, e.g., cellulose acetate hydrogen phthalate, cellulose acetate hydrogen glutarate, carboxymethyl hydroxyethyl cellulose, and sodium carboxymethyl cellulose. Column 5, lines 20-40; Examples 1-10, 11-15, 16-19, and 30.

Ishii discloses a process for making modified cellulose acetate object having improved solvent resistance. The Ishii process comprises forming or molding mixed cellulose ester made by esterifying cellulose with acetic acid and ***polybasic carboxylic acid***, and treating the formed or molded product with an aqueous solution of a water soluble polyvalent metal salt. Ishii further discloses that the mixed ester of cellulose, which is like cellulose acetate, is treated with a divalent or higher metal salt to increase its solvent resistance. Column 2, lines 37-40. Ishii indicates that the treated cellulose acetate is insoluble in acetone. Examples, Tables 1 to 7. Moreover, Ishii discloses that the degree of substitution of the hydroxyl groups of cellulose by acetate groups is at least 2.3, that the degree of substitution of the hydroxyl groups of cellulose by polybasic carboxylic acid groups is at least 0.15, and that the total degree of substitution of the hydroxyl groups of cellulose is at least 2.4. See e.g. Ishii claim 3.

Takeda discloses a process for producing a cellulose triacetate film which comprises a flow casting process comprising feeding a dope having a concentration determined by the amount of cellulose triacetate and other components in a mixed solvent containing methylene chloride and solidifying the dope by drying. The Takeda drying process comprising stripping the cast film from the support and drying the cast film.

Malm discloses a method for preparing a stable cellulose acetate having an acetyl content of at least 44.3 percent. The Malm process comprises acetylating cellulose with a mixture comprising acetic anhydride and sulfuric acid catalyst.

Comparison of the present invention and the cited references

The cited references fail to teach or suggest a soluble cellulose triacetate compound having a specific free carboxylic group originated from cellulose, in which the cellulose triacetate compound is formed by the reaction of cellulose with a reactant consisting essentially of acetic anhydride -- that is, ***without using a dibasic or polybasic carboxylic acid as the reactant!***

Finlayson, Takeda, and Malm are silent on the role of a free carboxyl group in cellulose triacetate. Sullivan and Ishii neither teach nor disclose the formation of a cellulose triacetate by the reaction of cellulose with a reactant consisting essentially of acetic anhydride. (In an interview on January 18, 2002, Examiners Everett White and Gary Geist suggested that the prior art rejection including Sullivan and Ishii could be overcome by specifying in the claims that the acetic anhydride reactant consists essentially of acetic anhydride, thus excluding polybasic acids such as the dibasic and tribasic acids of Sullivan and Ishii.)

Thus the cellulose triacetate derivatives of the present invention are clearly distinct from the cellulose triacetate of Finlayson, Takeda, and Malm and the cellulose acetate derivatives of Sullivan and Ishii. Accordingly, since none of the cited references teaches or suggests a cellulose triacetate, even if these references were combined, the cellulose triacetate derivatives of the present claims would not be obvious therefrom to a person having ordinary skill in the art.

Unexpected advantages

The present invention provides unexpected advantages. Not one of the cited references teaches or suggests an important role, in connection with the

releasability and spinnability of the dope, of the free carboxyl groups bonding directly to the cellulose triacetate.

More particularly, since Finlayson, Takeda, and Malm fail to suggest a cellulose triacetate compound having a free carboxyl group, the effects of the present compounds having those groups is not predicable from these references. Sulfuric acid is used as a catalyst in Finlayson and Malm. Sulfuric acid generates a cellulose having a sulfonic acid group. In conventional practice, a stabilizing treatment -- addition of an excessive amount of stabilizing agents such as alkali metal and alkali earth metal -- is usual, because the sulfonic acid group accelerates hydrolysis of cellulose triacetate. Moreover, as established in our response dated February 21, 2002, cellulose and hemicellulose originally have a carboxyl group. As a result of the stabilizing treatment, not only the sulfonic acid group but also the carboxylic group is neutralized to form salts thereof. However, although the stabilizing treatment is necessary to stabilize the cellulose triacetate, the metal salt of carboxylic group formed by the stabilizing treatment deteriorates the releasability and spinnability of the cellulose triacetate.

Malm corresponds to Comparative Example 1 in the present specification, because the free sulfuric acid is completely neutralized with a magnesium or calcium neutralizing agent. See column 1, lines 41-42, and claim 1. Moreover, since Finlayson does not mention a metal such as an alkali metal or an alkaline earth metal regardless of using a catalyst such as sulfuric acid (page 1, left column, line 15), sulfonic acid groups originating from the acidic catalyst will bond to the cellulose triacetate in Finlayson, deteriorating its optical characteristics such as yellowness index because of hydrolysis of cellulose triacetate by sulfonic acid groups. Furthermore, Takeda only

mentions the degree of acetylation of the cellulose triacetate and its raw material (column 5, lines 1-6) and provides no disclosure of the important role of carboxylic groups in a cellulose triacetate derivative.

Regarding Sullivan, carboxyl groups of the cellulose derivative of Sullivan reduce pH of the image layer in order to improve the diffusion image layer, but the improvement of diffusion image layers has no relevancy to the releasability of a dope. Thus the releasability of the cellulose triacetate composition of the present invention would not be expected based upon the teachings of Sullivan, it being noted that there are significant differences in function between the carboxyl groups of dibasic acid half-esters of cellulose as in Sullivan and carboxyl groups of cellulose triacetate as claimed herein.

Regarding Ishii, the improvement in the solvent resistance sought by Ishii is irrelevant to releasability of a dope. In particular, carboxyl groups of polybasic carboxylic acids act as functional groups for increasing solvent resistance, which is significantly different from dope releasability. Thus the improved releasability of the cellulose triacetate dopes of the present invention is not predicable from Ishii.

In accordance with the present invention, then, since free carboxyl groups of the cellulose triacetate are retained or generated, the resulting cellulose triacetate derivative is dramatically improved in releasability, optical characteristics, and spinnability. These advantages of the cellulose triacetate compounds of the present invention are not predictable based upon the teaching of the cited references.

Commercial success

The present invention has achieved significant commercial success. The cellulose triacetate compounds of this invention can be used as raw material for making protective films for polarizations plates. Because of the high releasability and spinnability and good optical characteristics, the cellulose triacetate compounds of this invention are used by such suppliers of protective film for polarization plates as Fuji Photo Film Co., Ltd. and Konica Corporation.

Furthermore, a great deal of follow-on patent activity attests to the commercial success of the present invention. For example, claims 4 and 5 of JP 2002-40244A only restrict the amount of alkali earth metal in feature (iii) of the present invention. Claim 1 of JP 2002-131536A discloses a cellulose ester which specifies a free acid content in the ester in features (i) and (iii) of the present invention. Claim 6 of JP 2002-212338A is a cellulose ester which has almost the same restriction as feature (ii) of the present invention. Claim 1 of JP 2002-179838A is a cellulose acylate solution in which almost the same cellulose ester as in feature (ii) of the present invention is dissolved in a specific solvent. Claims 10-12 of US 6,320,042 B1 only restrict the molecular weight of the cellulose ester of feature (iii) of the present invention. Therefore, based on the excellent advantages of the present invention, the present invention not only prospers in business, but also is widely utilized in industry. The present invention clearly satisfies all of the requirements for patentability.

Conclusion

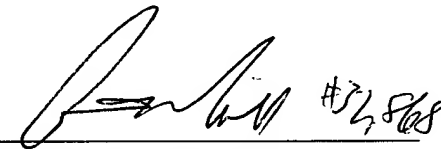
If any issues remain to be resolved in this application, the Examiner is requested to contact Richard Gallagher (Reg. No. 28,781) at (703) 205-8008.


Pursuant to the provisions of 37 C.F.R. §§ 1.17 and 1.136(a), the Applicants hereby petition for an extension of one (1) month to August 28, 2003, in which to file a reply to the Office Action. The required fee of \$110.00 is enclosed herewith.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 CFR 1.16 or under 37 CFR 1.17, particularly extension of time fees.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

By  #21,066
for Raymond C. Stewart
Reg. No. 21,066

RCS/RG 

P. O. Box 747
Falls Church, VA 22040-0747
(703) 205-8000